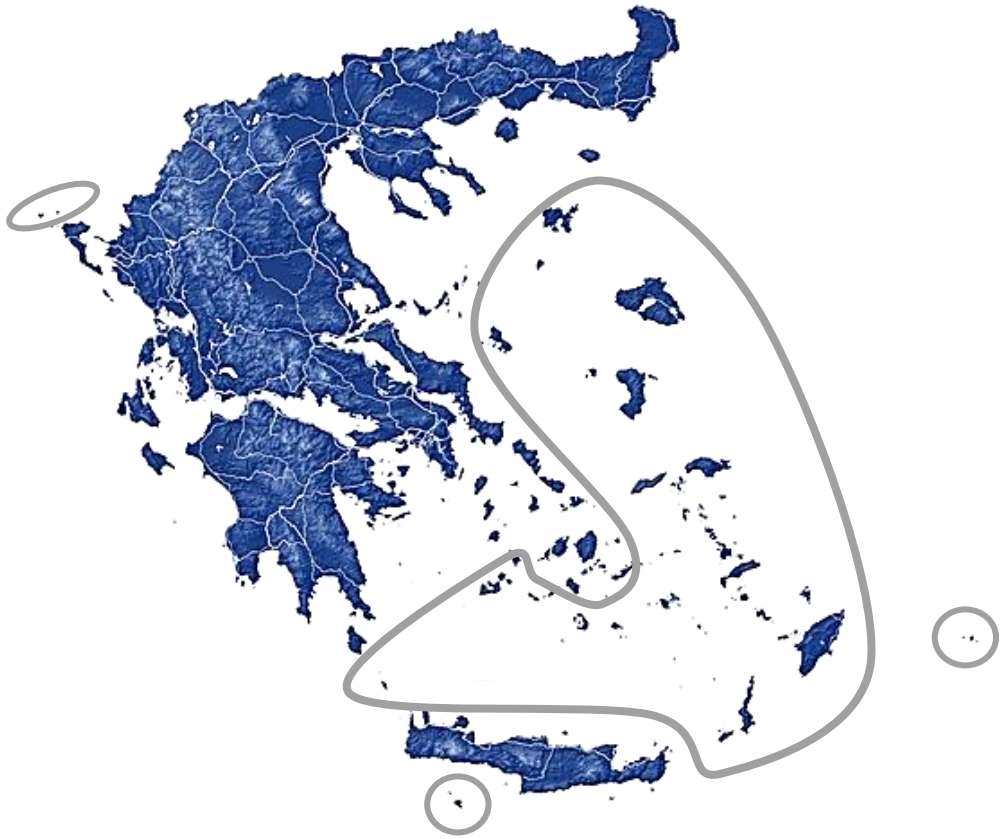
Non-Interconnected Islands

15.05.2025

Islands Network Operation Department

Non-Interconnection Islands (NIIs)



1
Small interconnected Island
(Crete)

(Peak Demand ≥ 650 MW)

28 **Electrical Systems**

2 Big
(Rhodes
Kos-Kalymnos)

(Peak Demand ≥ 100 MW)

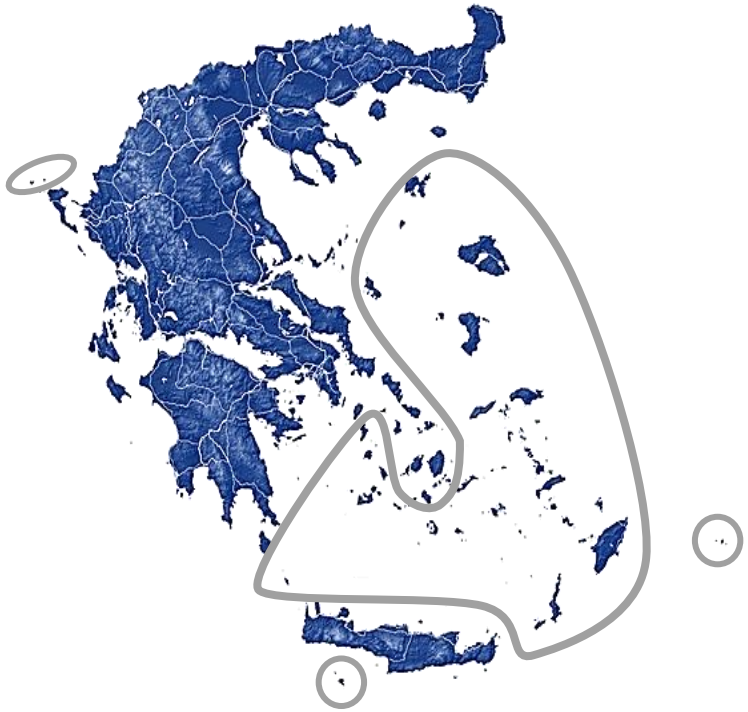
11 Medium
(Peak Demand 5MW - 100 MW)

- Thira - Santorini
- Ikaria
- Karpathos
- Lesvos
- Limnos
- Milos
- Patmos
- Samos
- Sifnos
- Chios

16 Small
(Peak Demand ≤ 5MW)

- Ai Stratis
- Agathonisi
- Amorgos
- Anafi
- Antikithira
- Arkioi
- Astypalaia
- Gavdos
- Donousa
- Ereikousa
- Kythnos
- Megisti
- Othonoi
- Serifos
- Skiros
- Simi

Non-Interconnection Islands' (NIIs) Profile



28 Autonomous Electrical Systems

- **2 large** (peak load over 100 MW)
- **10 medium** (peak load from 5MW up to 100 MW)
- **16 small** (peak load up to 5MW)

1 Small interconnected Island (Crete) (Peak Demand ≥ 650 MW)

30 Thermal Power Plants

Total Capacity: ~ **1 GW**

~700 RES Installations

Total Capacity: ~**170 MW**

- **52 Wind Parks**
- **650 PVs**
- **3 Hybrid Power Stations**

Self-producers

- **960 rooftop PVs**
- **400 net metering PVs**
- **Total Capacity: ~10 MW**

NIIs Challenges and Specifics

Isolated Electrical Systems:

- Single feeding- no alternative- great variations among islands' characteristics (between 100 kW and 650 MW): different capacity mechanism
- Special conditions per island – maintain voltage and frequency for each and every of the 28 isolated electrical systems
- Technical constraints impact on the RES exploitation (requirement for rotating reserve)

Seasonality showing great deviation between minimum and maximum load (summer)

Single conventional units'producer on each island

- Old units
- Predefined energy mixture and unit size

Production technology has not been adapted to new era requirements (Thermal & RES units)

- Due to technical and regulatory special conditions

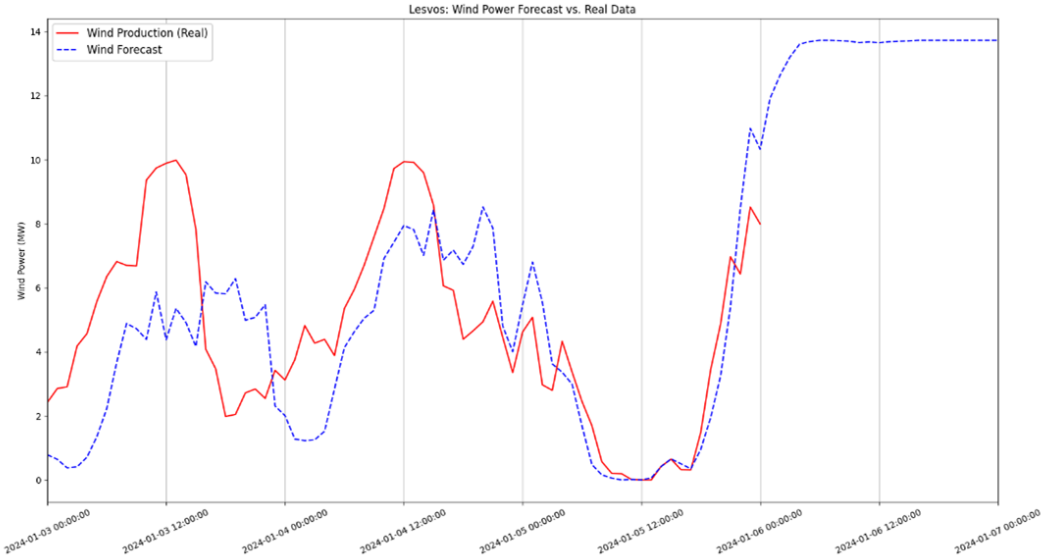
- **Volatile regulatory framework**
- **Technical constraints for RES margins** – maximum RES margin while keeping the ES stability according to regulator's decisions
- **Ancillary services to be offered by several producers**

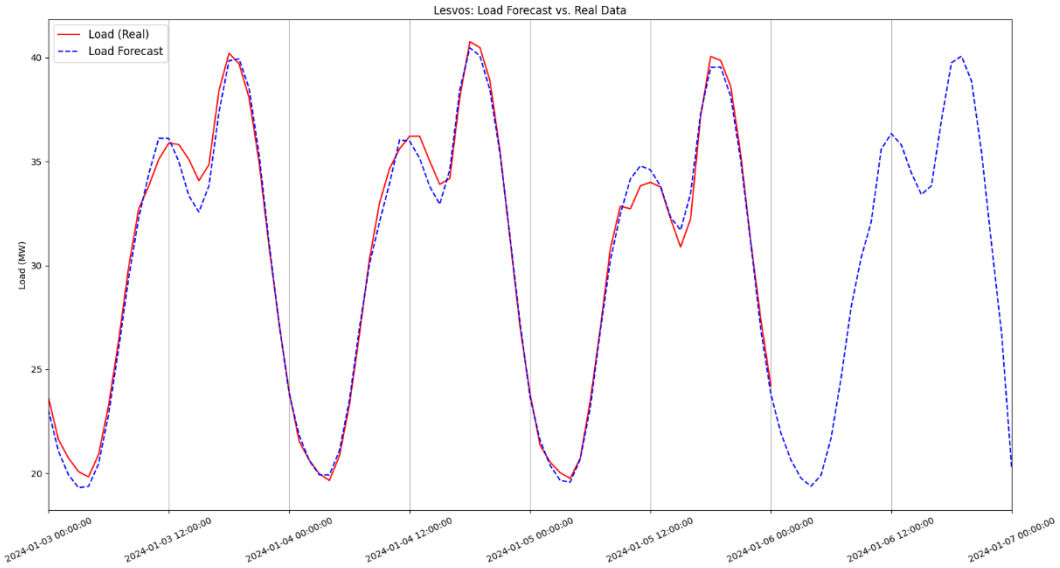
Great wind capacity

High solar irradiation

Load and wind forecast

- Historical load and production data
- Meteorological forecasts
- Neural Networks training

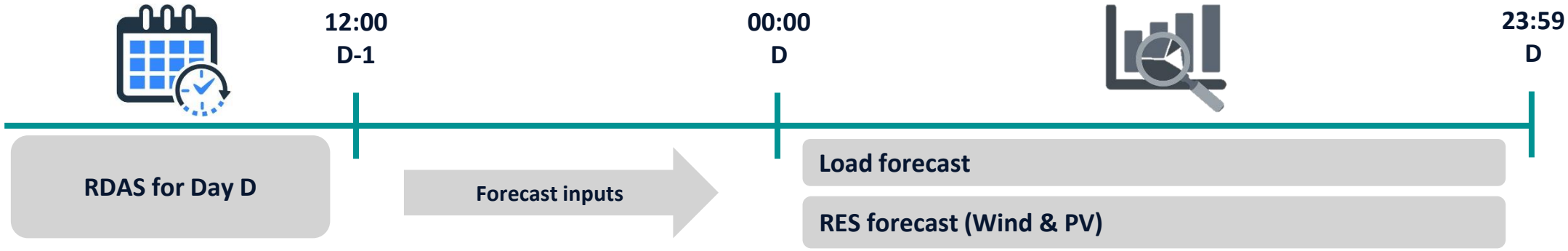


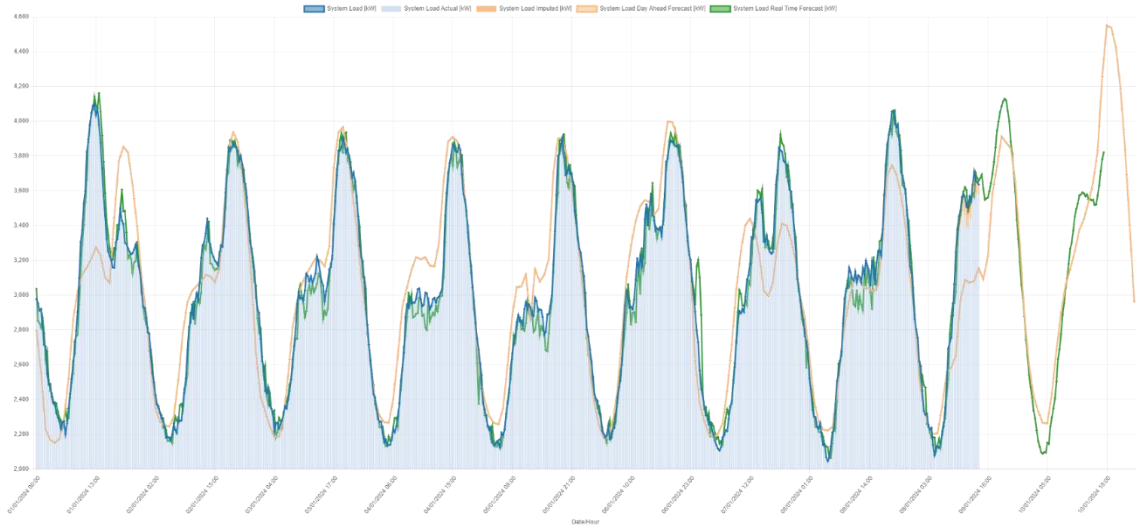


OUTCOMES & BENEFITS:

- Load and RES Production are estimated per hour
- Inputs of RDAS
- RES potential exploitation

Rolling Day-ahead-scheduling (RDAS)





OUTCOMES & BENEFITS :

- Production optimal exploitation
- Reliable feeding
- Ad-hoc reserves
- Cost minimization

Standard SCADA-EMS functionalities

Basic SCADA functionalities	**Real time supervision and operation** (1 sec time granularity). Production data and management results are stored in database.
	**Automated** management procedures **for wind & HPS managmenent – no need for human intervention**
	**PV estimation per island**, based on sampling of real time field measurements, estimation to be refreshed every minute
	**RES penetration to be maximised** while maintaining grid stabuility and reliable feeding of the islands
	**Availability declarations for RES & thermal units – Production declation for HPS** **Load & RES forecast - > Rolling Day Ahead scheduling**
Control Centre Functionalities	Real-time scheduling & dispatch
	Management on islands under very high RES penetration

Development of SCADA Systems for EMS

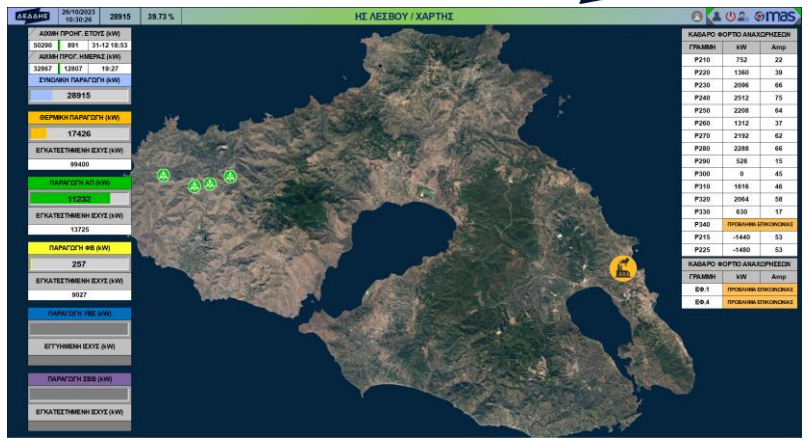
Central Control Room

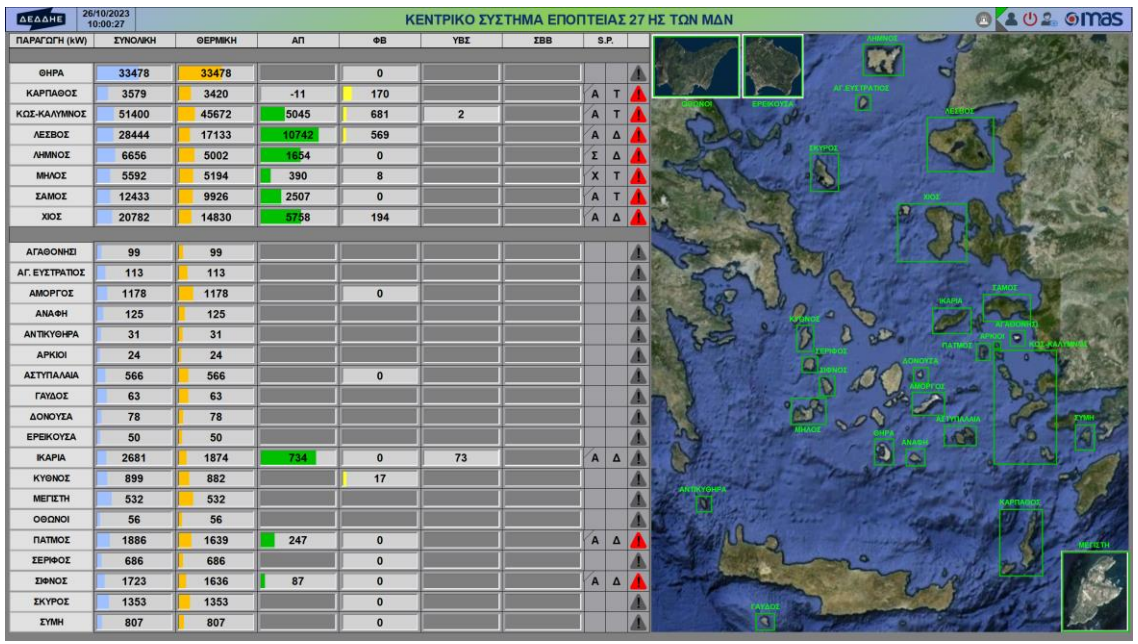
- Located in Athens in the NII Department's offices
- Operates Local Control infrastructures of the islands

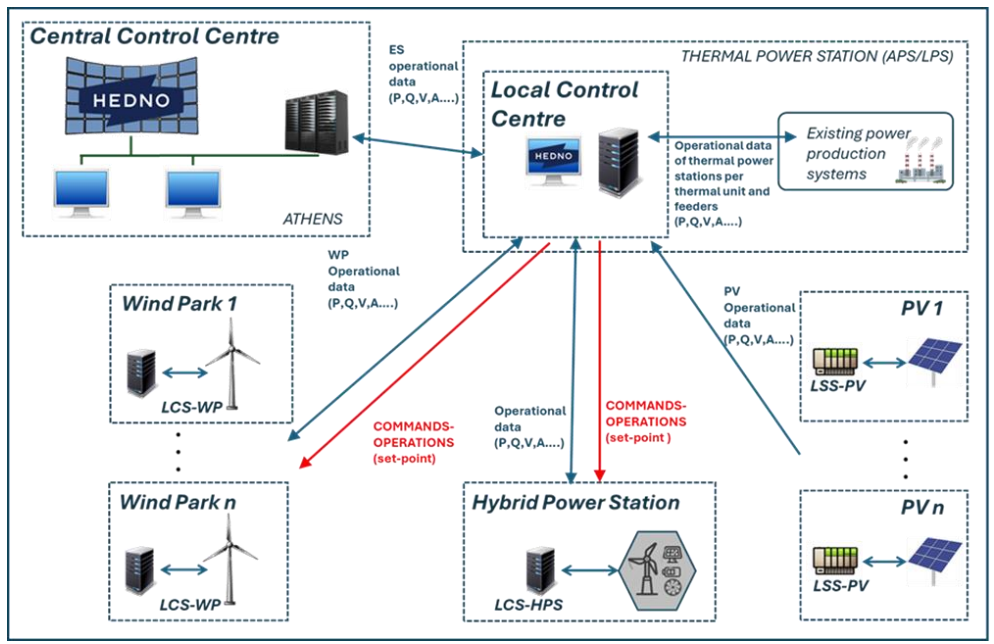
SCADA –EMS architecture for the 28 NIIs

ICT infrastructures

- Central Control Infrastructure in Athens
- 28 Local SCADA systems on every island
- 39 Local Control systems for the Wind Parks
- 3 Local Control systems for the Hybrid Power Stations
- 80 Local Supervision Systems for PVs



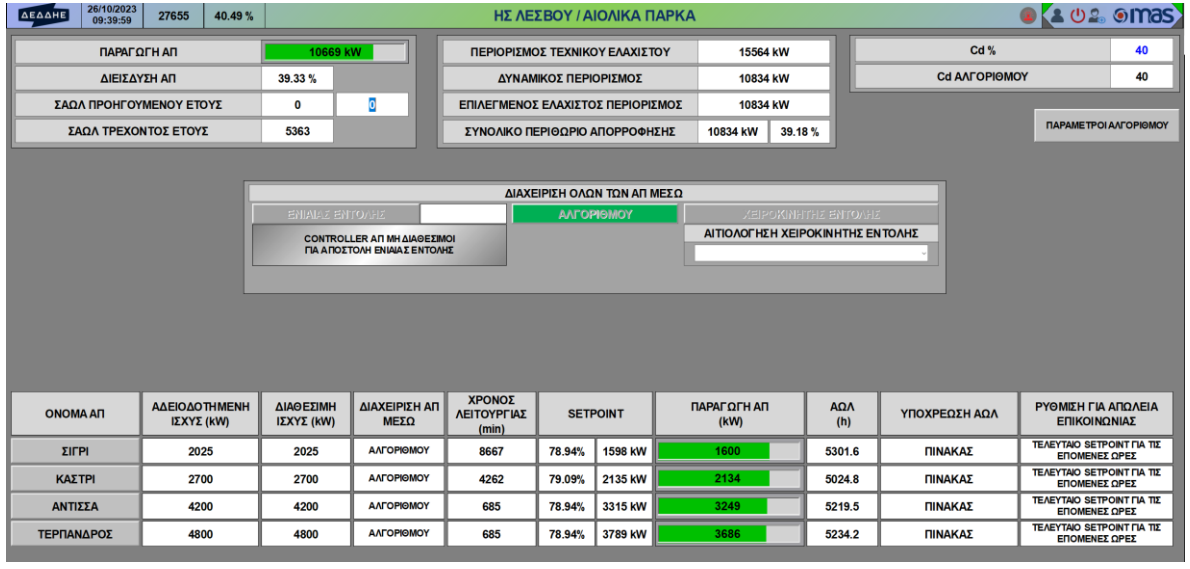


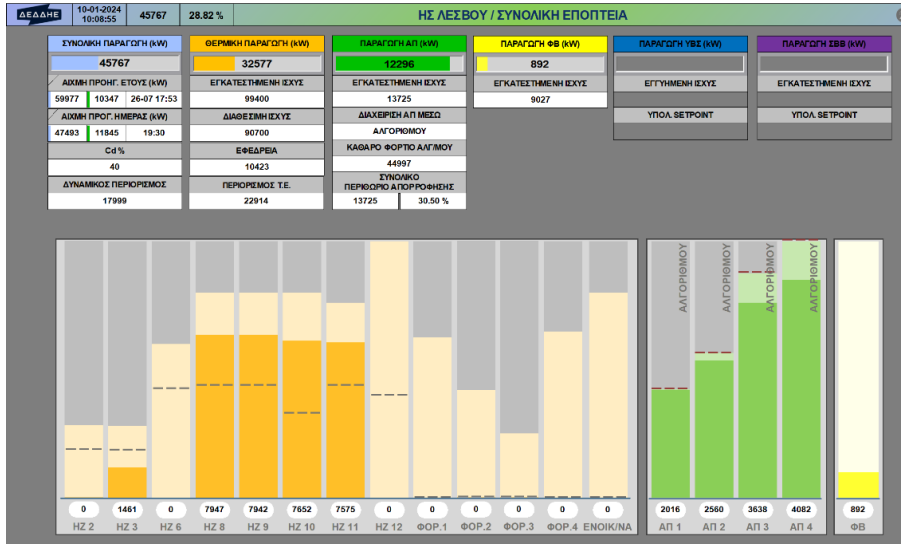


Management of RES from the SCADA-EMS

Management algorithm

- Algoritmhm operation cycle , 1 minute
- Constraints imposed by the thermal units in operation and the WP dynamic penetration coefficient (Cd)
- Automatically reduction of the Cd through an algorithm under specific predifined conditions





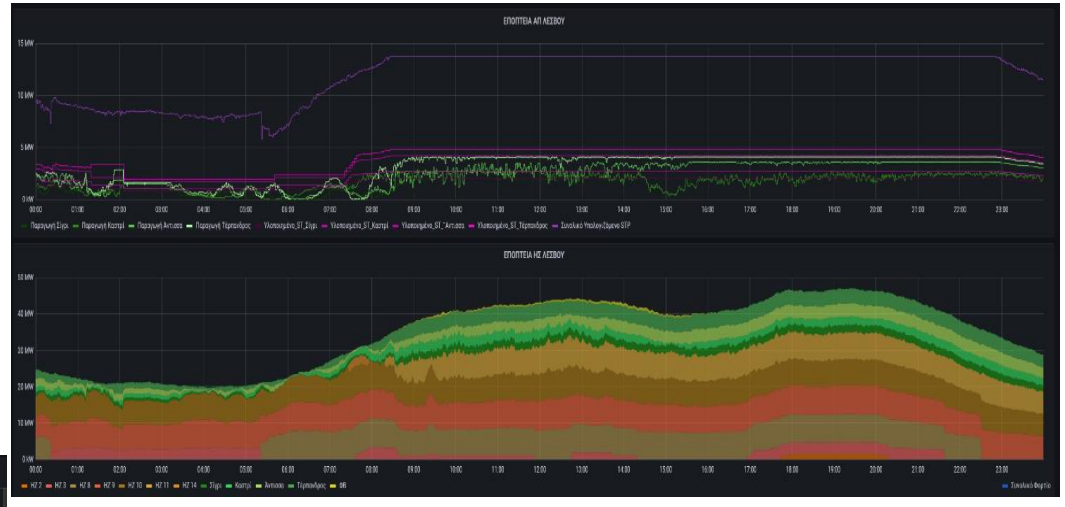
Results – Benefits :

- Equality and transparency in WP and HPS management
- Automated management procedure - reducing human intervention
- Predicted behaviour of the WPs in cases of communication loss

Graphical overview of real time data

Development of Business Intelligence Tools

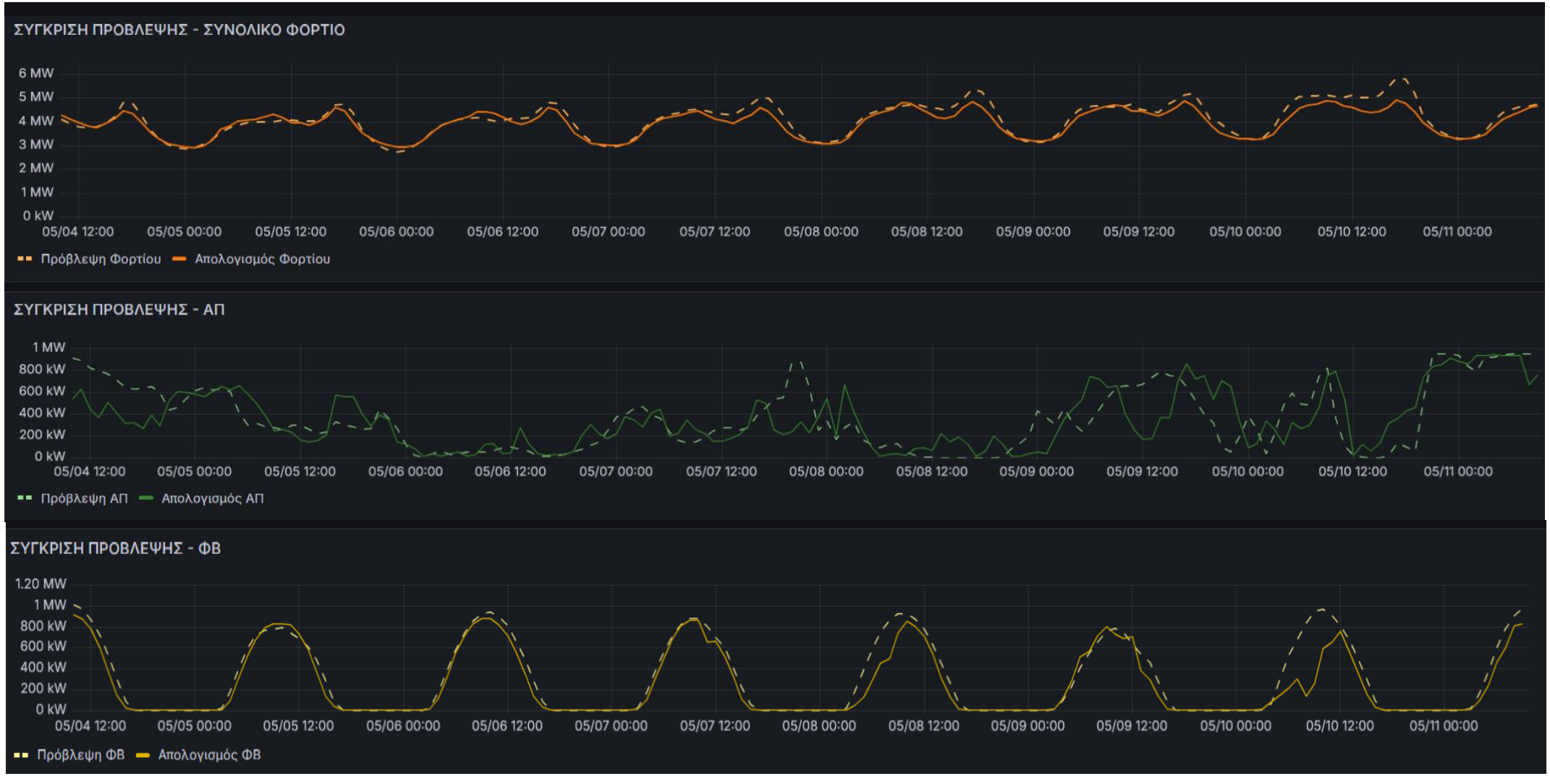
- Big Data Analytics
- Connection with DB to data resolution of a sec
- User friendly graphics and custom reporting for each user



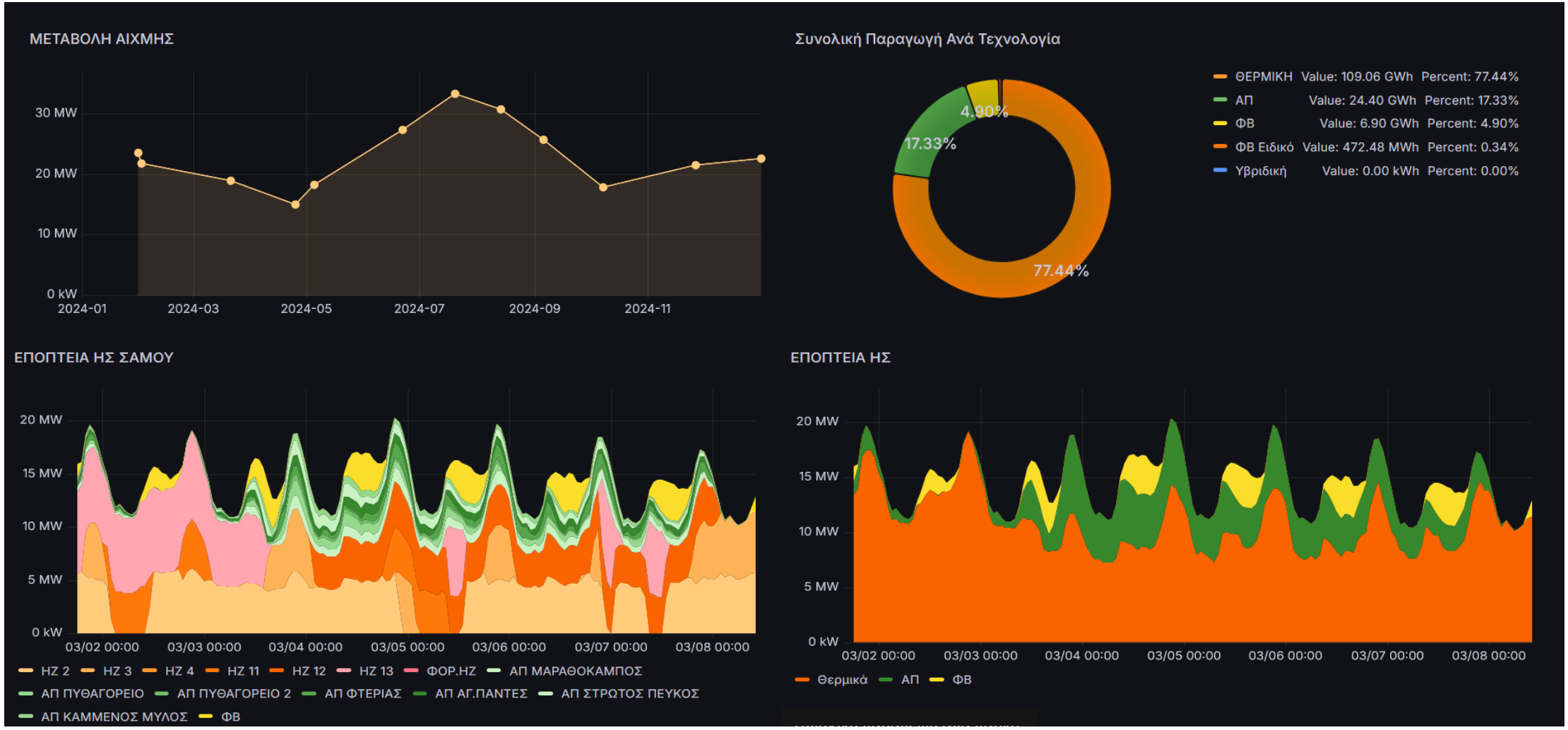
Results – Benefits :

- Quick overview
- Ad-hoc changes in managing RES
- KPIs (RES penetration, time offline, etc.)
- Feedback and evaluation of aforementioned changes

Forecast – Real time production

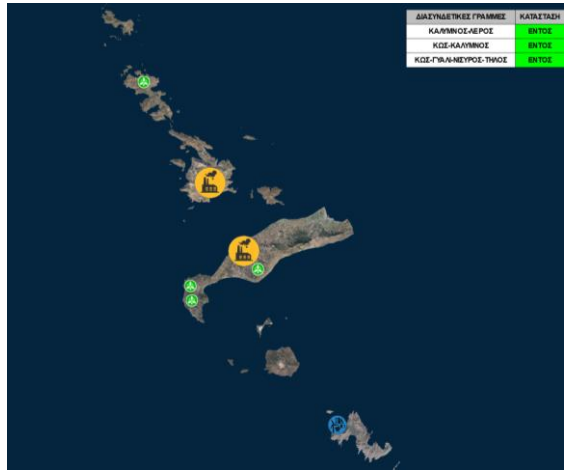


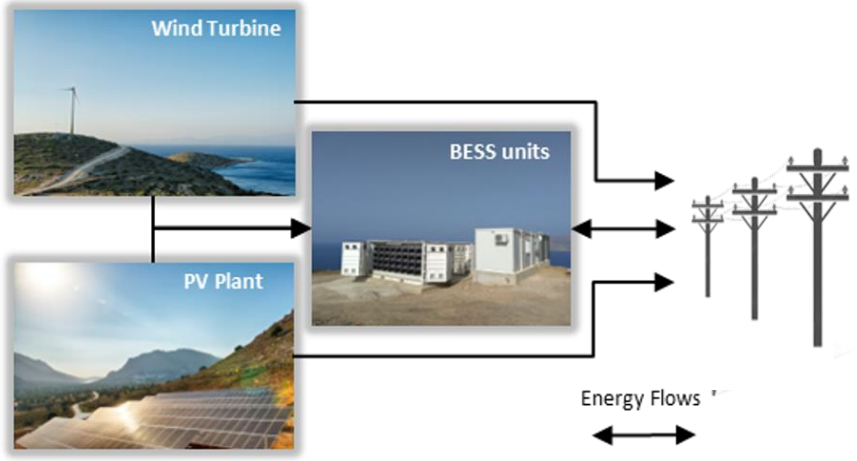
Data analytics

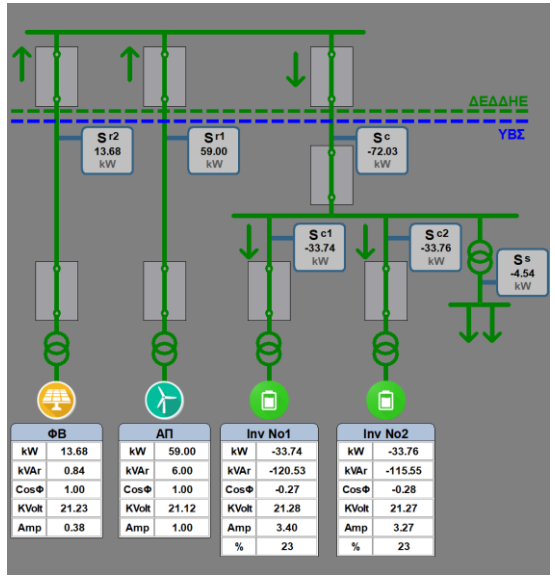


Tilos HPS (on Kos-Kalymnos Electrical System)

- Kos-Kalymnos island complex consists of 9 islands
- $\mathbf{APD_5}$ = 94,8MW
- Batteries NaNiCl2 : 2,4MWh
- Wind turbine 800kW
- PV 160kWp
- Guaranteed power 400 kW
- In operation since 10/2019
- 100% exploitation



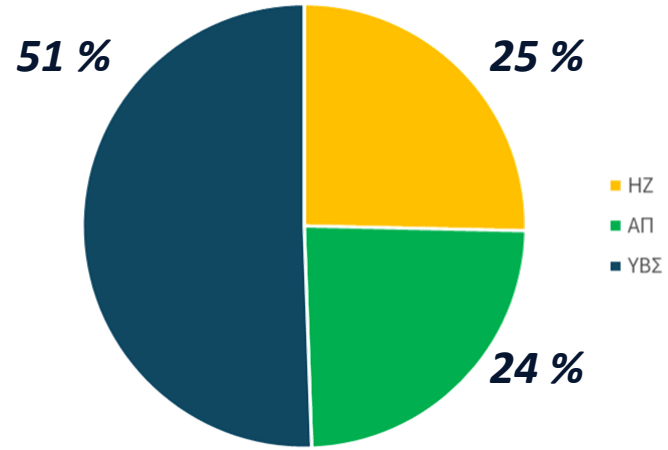


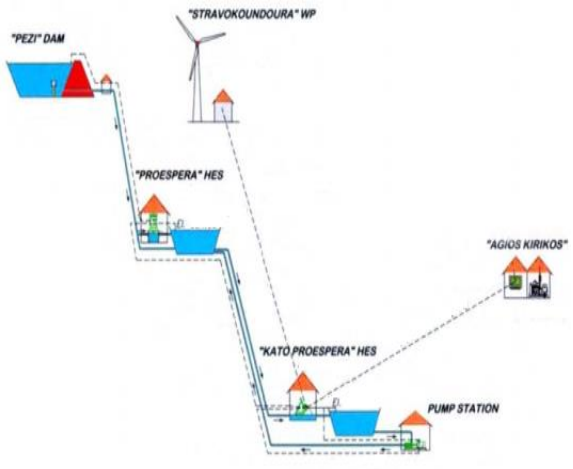


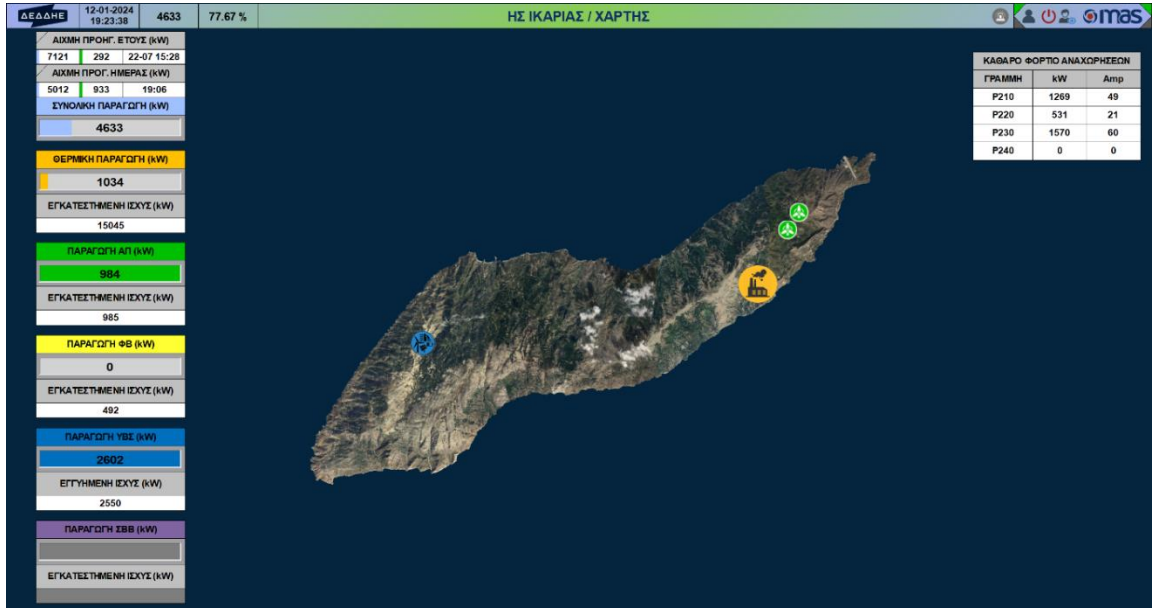
Ikaria HPS

Hybrid Energy Project (pump storage)

- Combines hydro and wind – guaranteed power **2,55 MW**
- APD_5 **= 7,3 MW.**
- Consists of 2 hydro stations **(1 MW & 3 MW)** ,
  2 water reservoirs gathering water and
  1 **wind park (2,7 MW)**.







Astypalea

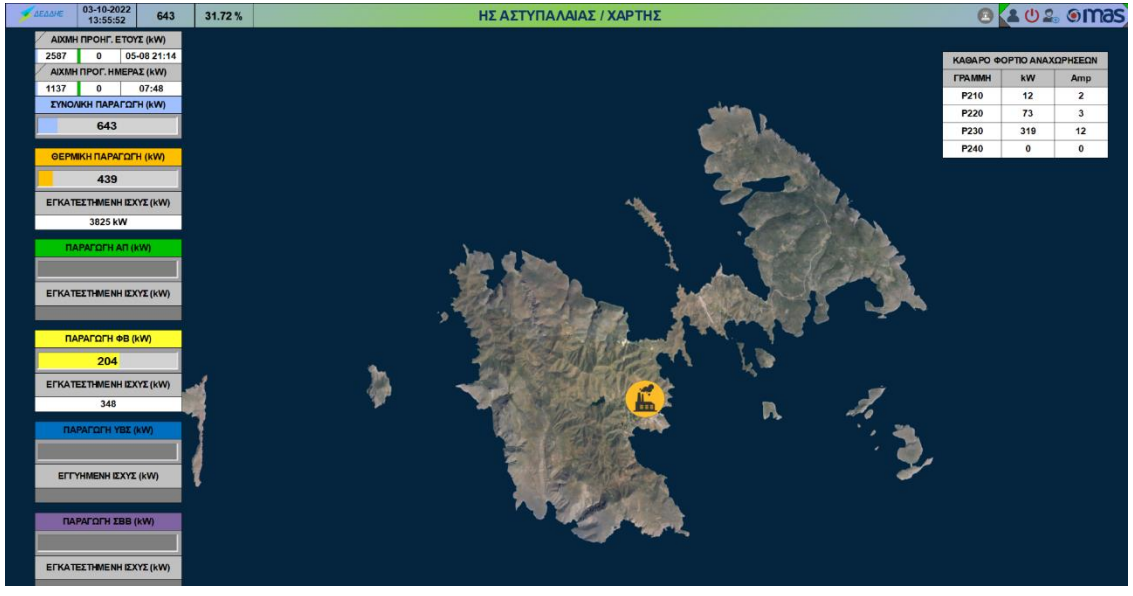
Currently

1 Thermal Power Station (~5.1 MW)

4 PV Stations (~0.3MW)

9 Prosumers (56.35 kW)

- 6 roof-top PV units (29.55 kW)
- 3 net metering PV units (26.8 kW)



Pilot Project in Astypalea

- ✓ **Hybrid Power Station:**
  - **PV (~3 MWp)**
  - **Battery Storage System (~7.2 MWh)**
- ✓ **Electric vehicles, as flexible loads**

To conclude…

Innovative ongoing projects:

Two small size islands (Ai Stratis, Astypalaia)

Hybrid power station with batteries - High RES Penetration up to 80% yearly

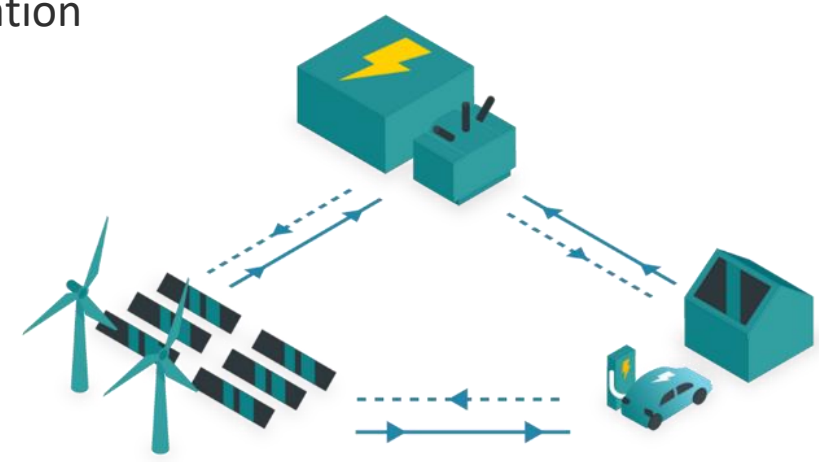
- [x] Thermal units to be switched off – frequency to be regulated by storage (battery/inverters)

Challenges to be faced

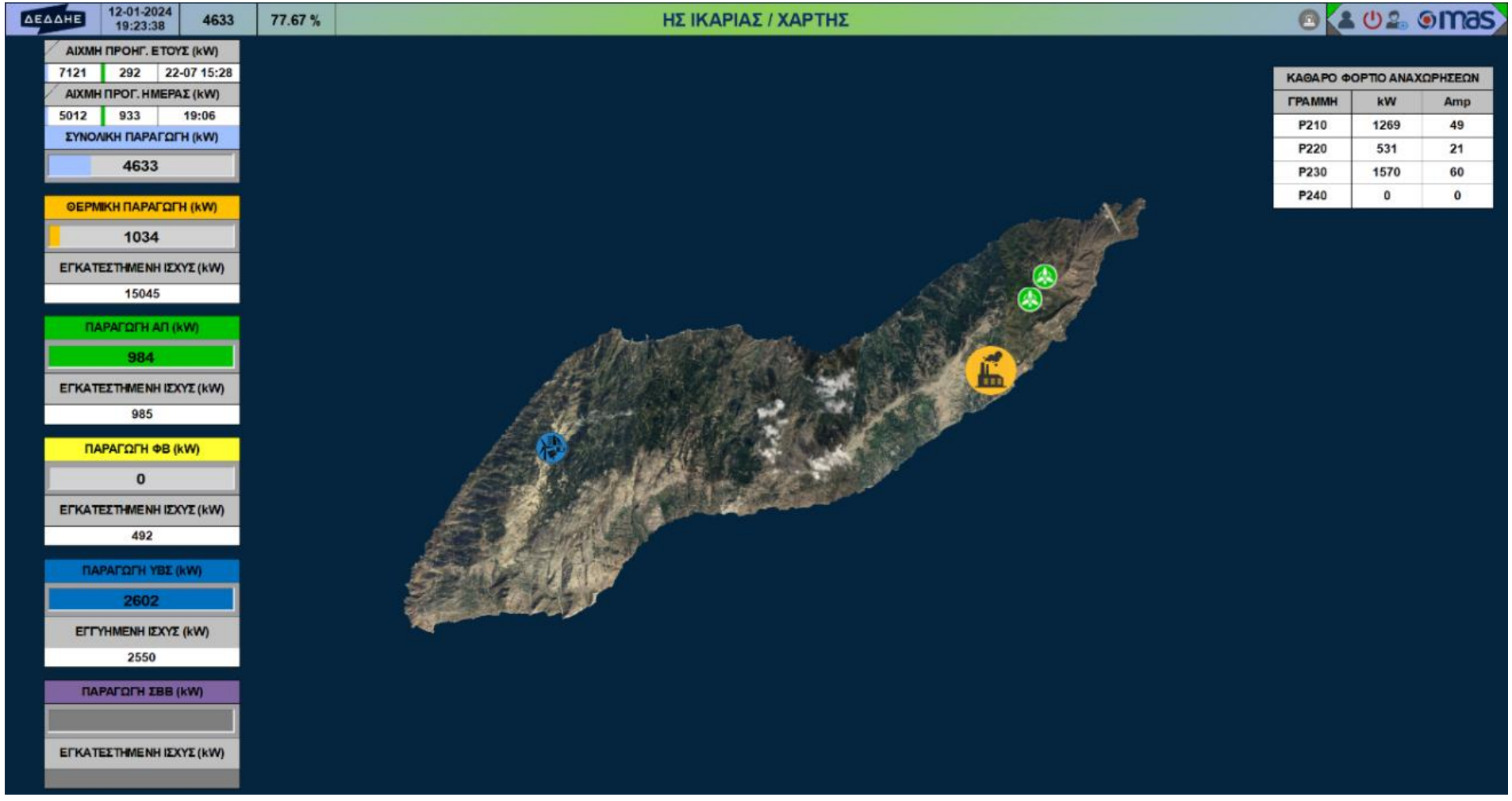
- [x] Smooth transition between alone operation of HPS and parallel operation

Droop adjustments

Automatic Generation Control fine tuning to include storage



Instant RES penetration of 78%



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